

*IMPACT OF KOKOMO BY-PASS
FROM 1950 TO 1964*

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by
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To: G. A. Leonards, Director
Joint Highway Research Project

September 24, 1965

From: H. L. Michael, Associate Director
Joint Highway Research Project

Project: C-36-64A
File: 3-5-1

The attached technical paper "Impact of Kokomo By-pass from 1950 to 1964" has been prepared by Messrs. Eugene Evans and Harold Michael. It was presented at the last Annual Purdue Road School and is scheduled for publication in the Proceedings of that Conference.

The paper is a summary of the impact research through 1964 on the Kokomo By-pass and presents findings which indicate the need for providing full control of access for such facilities. The impact on traffic conditions, land use and land value have been significant. The information presented should permit better planning and provision of such facilities in the future.

The paper will be submitted to the Highway Commission and to the Bureau of Public Roads for approval of the paper for publication.

Respectfully submitted,

Harold L. Michael

Harold L. Michael, Secretary

HLM:bc

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Technical Paper

IMPACT OF KOKOMO BY-PASS FROM 1950 TO 1964

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**Purdue University
Lafayette, Indiana
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INTRODUCTION

The tremendous increase in population and vehicle registration within the United States in recent years has created traffic snarls which are threatening to strangle many urban areas. An attempt to alleviate this congestion problem in the central portion of small to medium sized cities frequently has included the construction of by-pass routes which skirt the periphery of a city

Kokomo, Indiana was faced with this congestion problem, and in 1950 a by-pass facility east of the city was opened to traffic (see Figure 1). Initially the U.S. 31 By-pass satisfactorily served its intended purpose of conveniently and safely routing the through traffic around Kokomo, but the "long-range" usefulness of the by-pass for this purpose appears to be decreasing because of increased travel times and a large increase in accidents. The Kokomo By-pass, unfortunately, was constructed with little or no control of access.

The purpose of the investigation, which served as the basis for this paper, was to study the "long-range effects of a by-pass with little or no control of access.

The study included an analysis of traffic volumes, travel times, accidents, land use, land value, and an investigation of the properties which were partially taken for the right-of-way of the improvement. The primary purpose of the investigation was to provide information which could profitably be used when planning other by-pass facilities.

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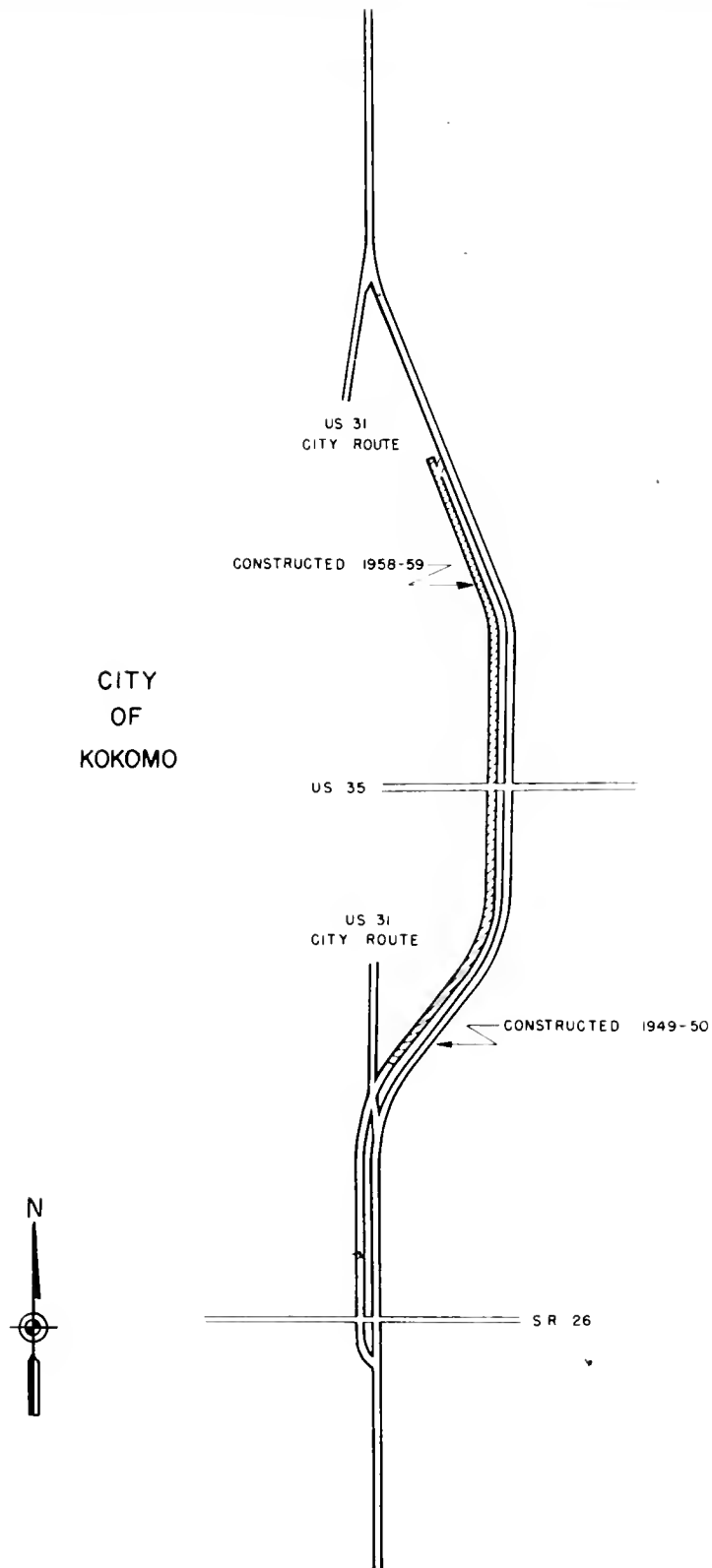


DIAGRAM SHOWING CONSTRUCTION STAGES OF THE U. S. 31 BY-PASS

FIGURE 1

The Study Area

Kokomo, as a city by that name, has a history dating back to 1844. Population increases within Kokomo and Howard County have been relatively steady (see Figure 2) and greater than the prevailing trend in Indiana.

Kokomo is situated in north central Indiana on a major north-south highway, U.S. 31. U.S. 35 connects the city to other metropolitan areas to the northwest and southeast while Indiana 22 passes in an east-west direction through the city (see Figure 3).

Three railroad lines provide service to Kokomo of which two are the property of the Nickel Plate Railroad, and the other is owned by the Pennsylvanian Railroad. Both passenger and freight service are available with ten freight trains and two passenger trains passing through the city daily. Faster passenger service is available at the Municipal Airport which is served by one commercial airline. Kokomo is also served by three bus lines of which one is local, one offers service in Indiana, and the third provides passenger service to all segments of the nation. Thirteen trucking agencies which are located in Kokomo offer their services to the inhabitants and to the industrial and commercial establishments in the greater Kokomo area.

A study of selected statistics for the ten year period from 1950 to 1960 for Howard County and the State of Indiana showed that population, income, labor, housing, and bank deposits for Howard County increased at a faster rate than the state average while the changes in retail trade, wholesale trade, and manufacturing were comparable to the state averages.(1)

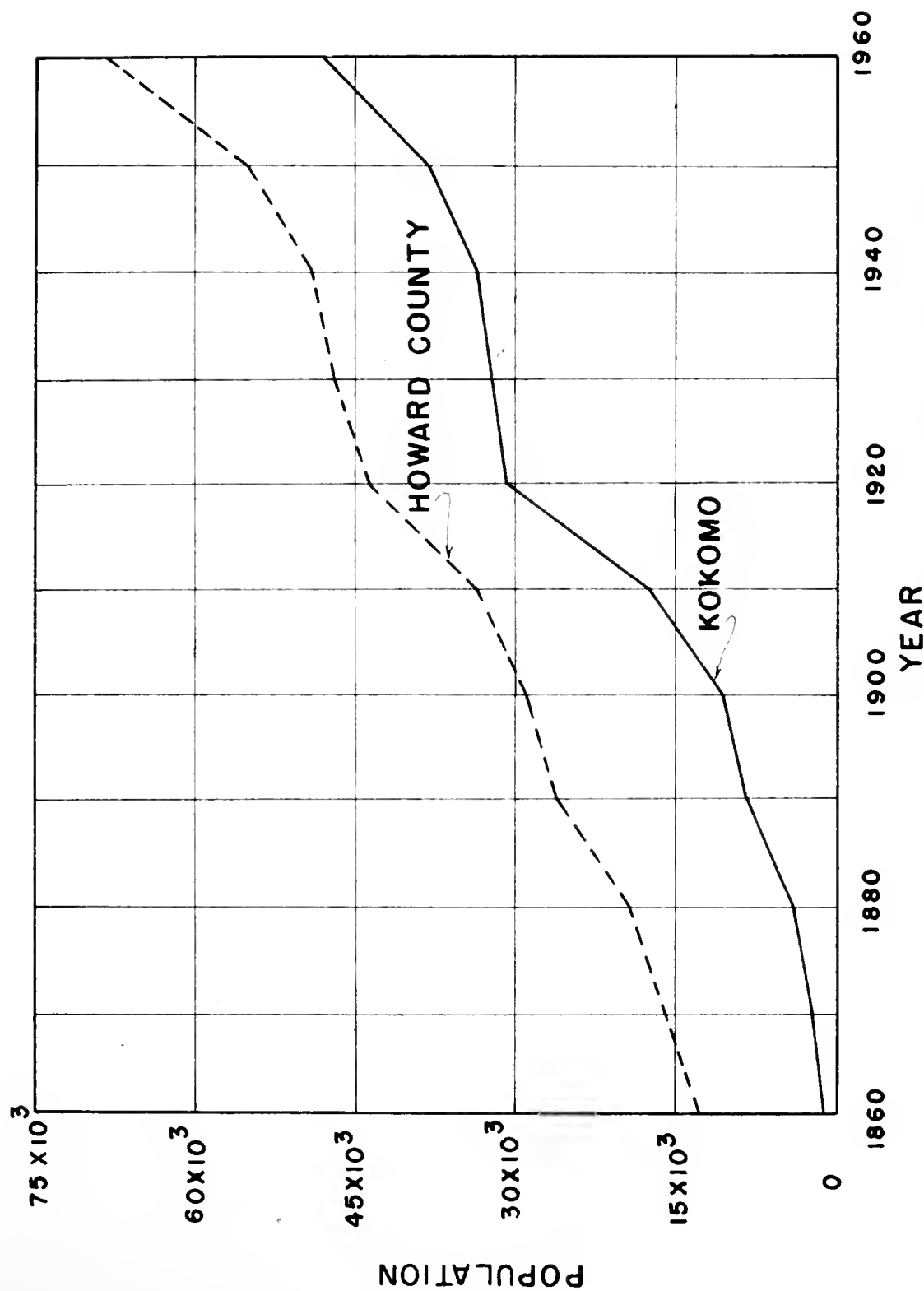


FIG.2 - POPULATION GROWTH OF KOKOMO AND HOWARD COUNTY

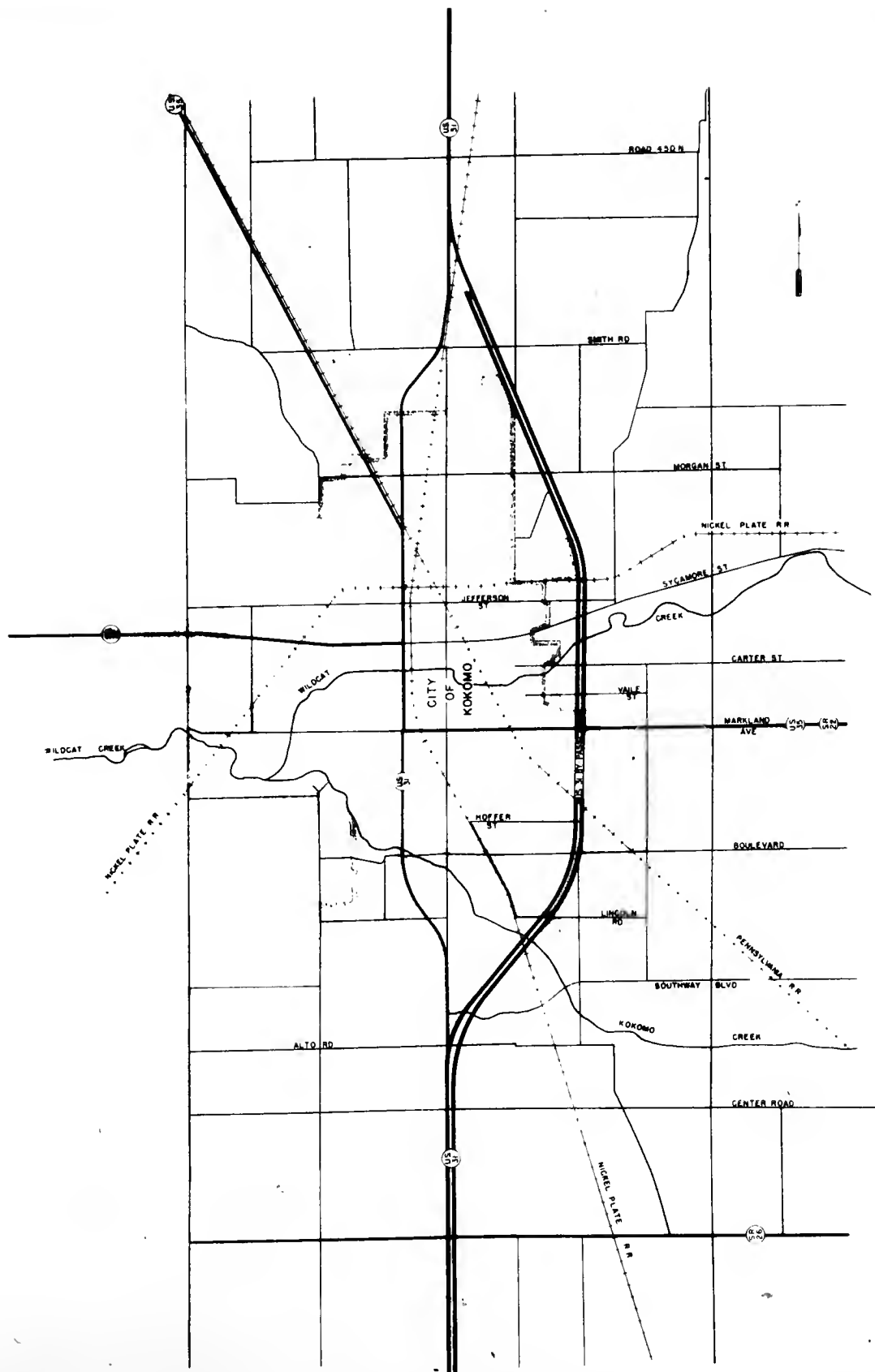


FIGURE 3 - MAJOR TRANSPORTATION ROUTES IN KOKOMO AREA

Traffic Volume

Traffic volume data are necessary in many phases of highway planning and engineering. These data are used in the geometric design of both new and old facilities, in determining appropriate traffic control devices, and in determining the degree of congestion at a given location. The growth of an area is reflected in traffic volume changes with time for the highway routes which serve it.

Traffic volumes in 1951 for the Kokomo By-pass and major intersecting streets are shown in Figure 4. (4). When these are compared to the corresponding volumes in 1964 (see Figure 5) a sizeable increase in volumes is noted.

With the large traffic volume increases have come traffic signals at several intersections, congestion, increased travel time, and an increase in accidents, all of which have reduced the operational efficiency of the by-pass. Because of increases in traffic volumes and a rapid growth of establishments adjacent to the by-pass, lower speed limits have necessarily been posted. With little imagination one can visualize the Kokomo By-pass as becoming a major bottleneck for traffic in the near future.

With no access control provided a route often loses some of its capacity, and this is indeed an undesirable characteristic of a non-controlled access facility. On the other hand, fully controlled access facilities have proved to be able to retain their original capacity.

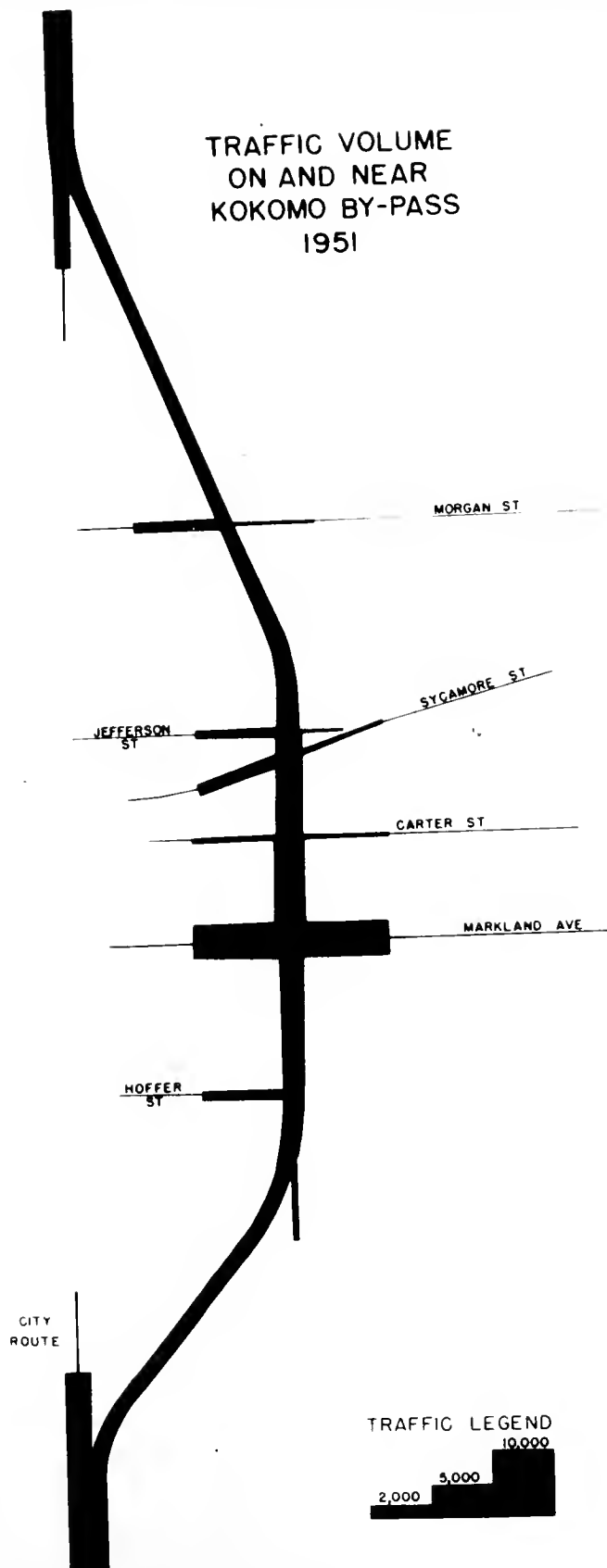


FIG. 4

TRAFFIC VOLUME ON AND NEAR KOKOMO BY-PASS 1964

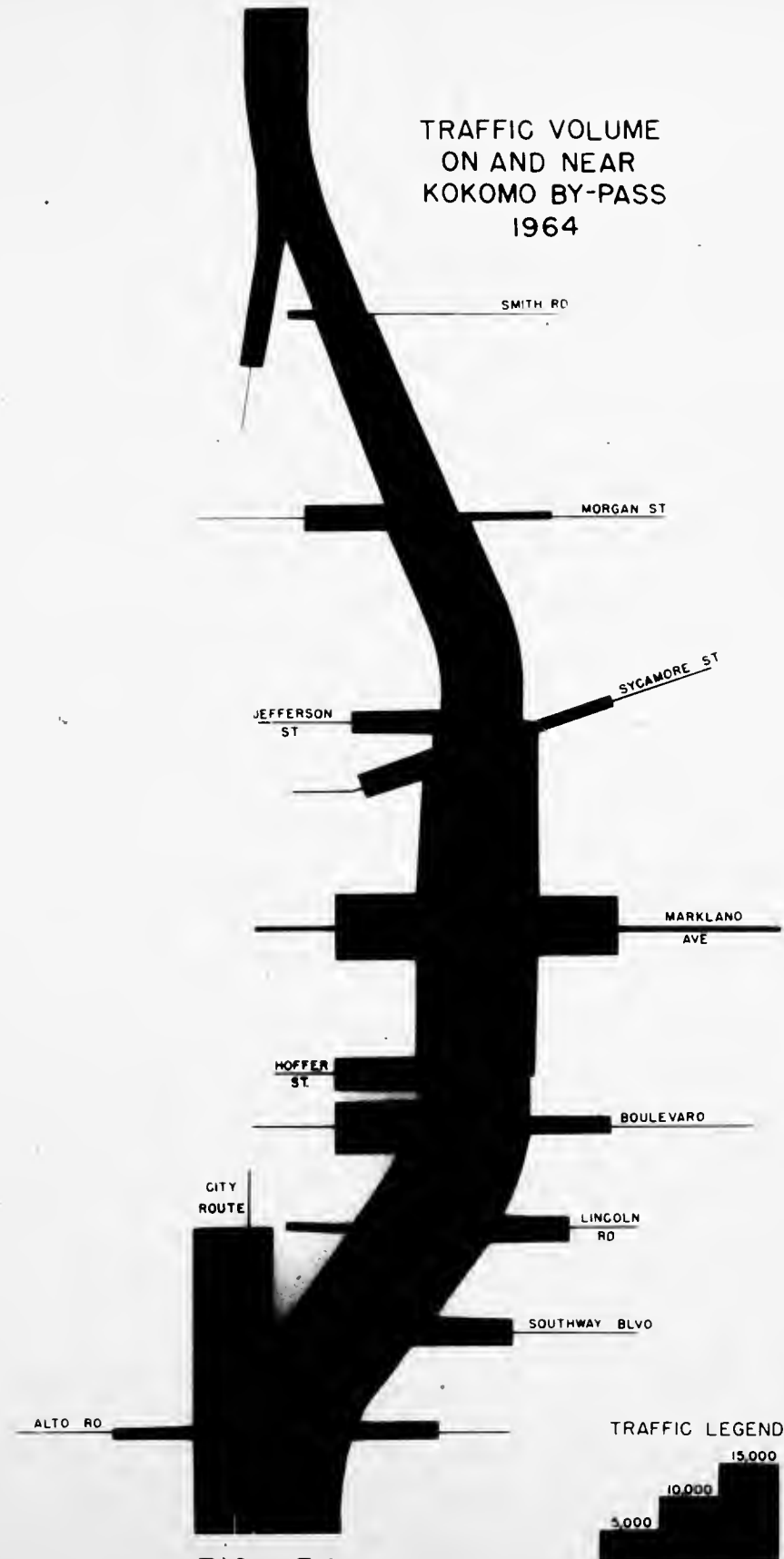


FIG. 5

Another factor which is significant is that both local and through traffic utilize the by-pass in heavy volumes. These incompatible uses were found to be a primary contributor to vehicular accidents and delay on the Kokomo By-pass. (6)

Travel Time

The primary purpose of a by-pass facility is to move traffic around a city in as short a period of time as practical. When the driver is given a choice of alternate facilities, he usually selects the route which minimizes travel time.

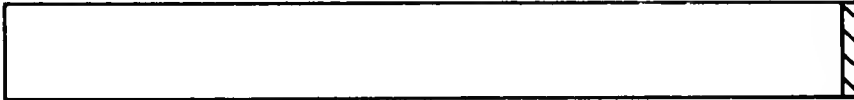
Travel time comparisons for the Kokomo By-pass from 1951 through 1964 are shown in Figure 6. The time required to traverse the by-pass has increased only slightly from 1957 through 1964. This small increase was possible only because of the construction of an additional two lanes in 1960 to provide a four-lane divided facility. A similar comparison of the travel times on the U.S. 31 city route through Kokomo is shown in Figure 7.

For an economic analysis the present Kokomo By-pass was compared with a fictitious Kokomo By-pass with full control of access. In the summer of 1964 the average speed in Indiana of free flowing passenger cars on four-lane divided facilities with full control of access was found to be 62.7 mph (2). Assuming that vehicles traveling on the Kokomo By-pass in 1964 would have traveled in the same volume on a fully controlled access facility and at this speed had the facility been of the freeway type, a net savings of approximately \$270,000 would have been realized by motorists in 1964. This figure is based solely on time lost by the motorist

U.S. 31 BY-PASS 1951
TWO-LANES

OVERALL TIME: 8 MIN. 43 SEC.

RUNNING TIME: 8 MIN. 38 SEC.

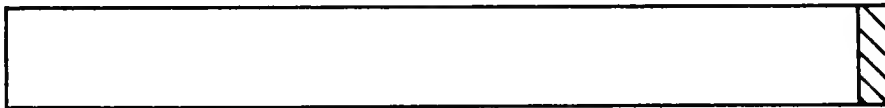


STOPPED TIME: 5 SEC.

U.S. 31 BY-PASS 1957
TWO-LANES

OVERALL TIME: 9 MIN. 05 SEC.

RUNNING TIME: 8 MIN. 46 SEC.

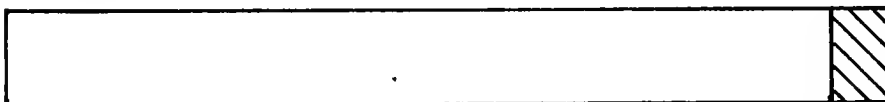


STOPPED TIME: 19 SEC.

U.S. 31 BY-PASS 1964
FOUR-LANES

OVERALL TIME: 9 MIN. 10 SEC.

RUNNING TIME: 8 MIN. 28 SEC.



STOPPED TIME: 42 SEC.

FIG. 6 - BY-PASS TRAVEL TIME COMPARISONS

BEFORE BY-PASS
U.S. 31 THROUGH KOKOMO 1950

OVERALL TIME: 14 MIN. 3 SEC.

RUNNING TIME: 13 MIN. 8 SEC.



STOPPED TIME: 55 SEC.

AFTER BY-PASS
U.S. 31A THROUGH KOKOMO 1951

OVERALL TIME: 15 MIN. 9 SEC.

RUNNING TIME: 13 MIN. 37 SEC.



STOPPED TIME: 1 MIN. 32 SEC.

AFTER BY-PASS
U.S. 31A THROUGH KOKOMO 1964

OVERALL TIME: 15 MIN. 55 SEC.

RUNNING TIME: 13 MIN. 13 SEC.



STOPPED TIME: 2 MIN. 42 SEC.

FIG. 7 - CITY ROUTE TRAVEL TIME
COMPARISONS.

traversing the by-pass at values suggested by the American Association of State Highway Officials. (7) It does not include such losses as increased stopping costs, operating costs, idling costs, starting costs, etc.

Accidents

The accident analysis which was conducted on the Kokomo By-pass indicates that many accidents can be related to a probable cause. An attempt was made to define areas with high accident rates and to determine those factors which contributed to the accident rate.

An accident spot map for the by-pass indicates that the majority of the accidents happen at intersections (see Figure 8). Accidents were most prevalent along the Kokomo By-pass at the following intersections: Markland, Sycamore, East Boulevard, Alto, and Southway Boulevard. The accident involvement rate was also high at the crossover at the north end of the by-pass.

A quality control analysis was one technique utilized to locate high accident sections along the by-pass facility. (5) For this analysis the by-pass was divided into six sections (see Figure 9). This method was used to isolate sections which were out of control because of measurable environmental factors.

Because it was surmised that the northbound and southbound lanes had different involvement characteristics, an accident rate was computed for each direction. The northbound accident rate for the years 1961-1963 per 100 million vehicle miles for the entire length of the by-pass was 350 while the southbound accident rate was 270.

ACCIDENTS	
PROPERTY DAMAGE	- 204
PERSONAL INJURY	- 94
FATAL	- 1
	<hr/> 299

ACCIDENT LEGEND

- PROPERTY DAMAGE
- PERSONAL INJURY
- ⊗ FATAL

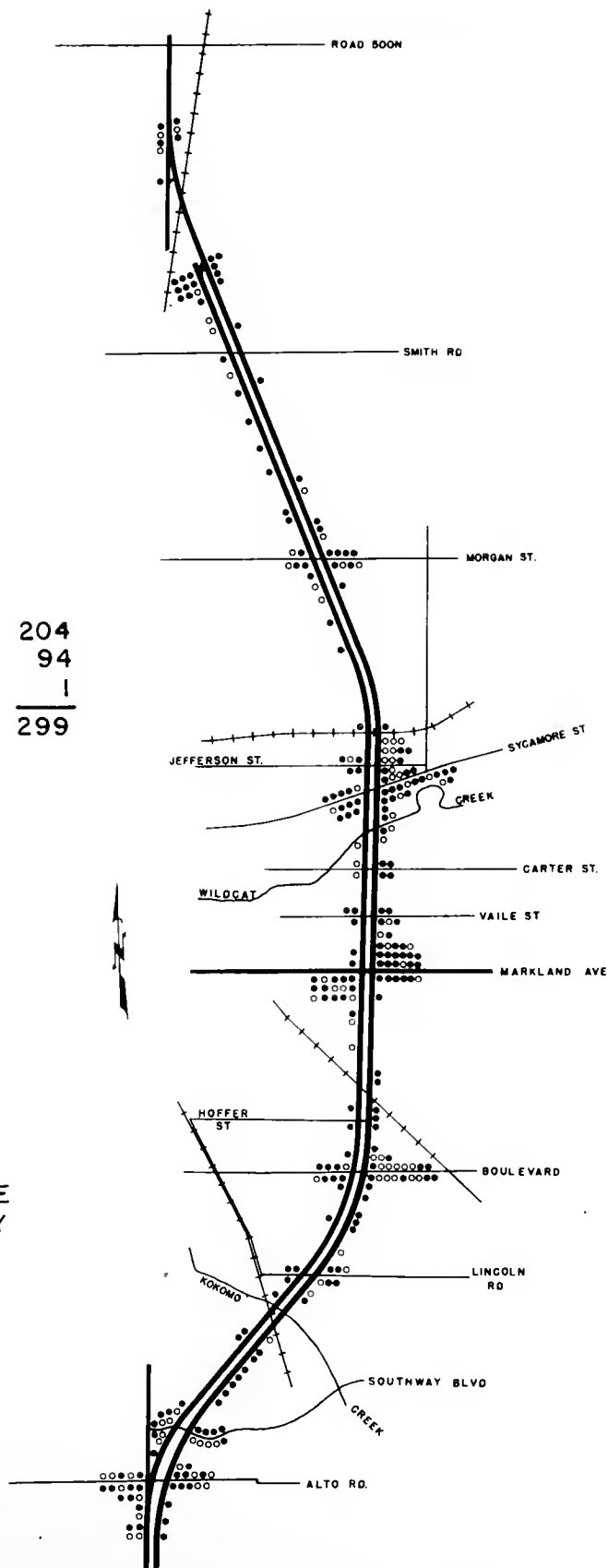


FIGURE 8 - ACCIDENT SPOT MAP FOR KOKOMO BY-PASS FOR 1961, 1962 AND 1963.

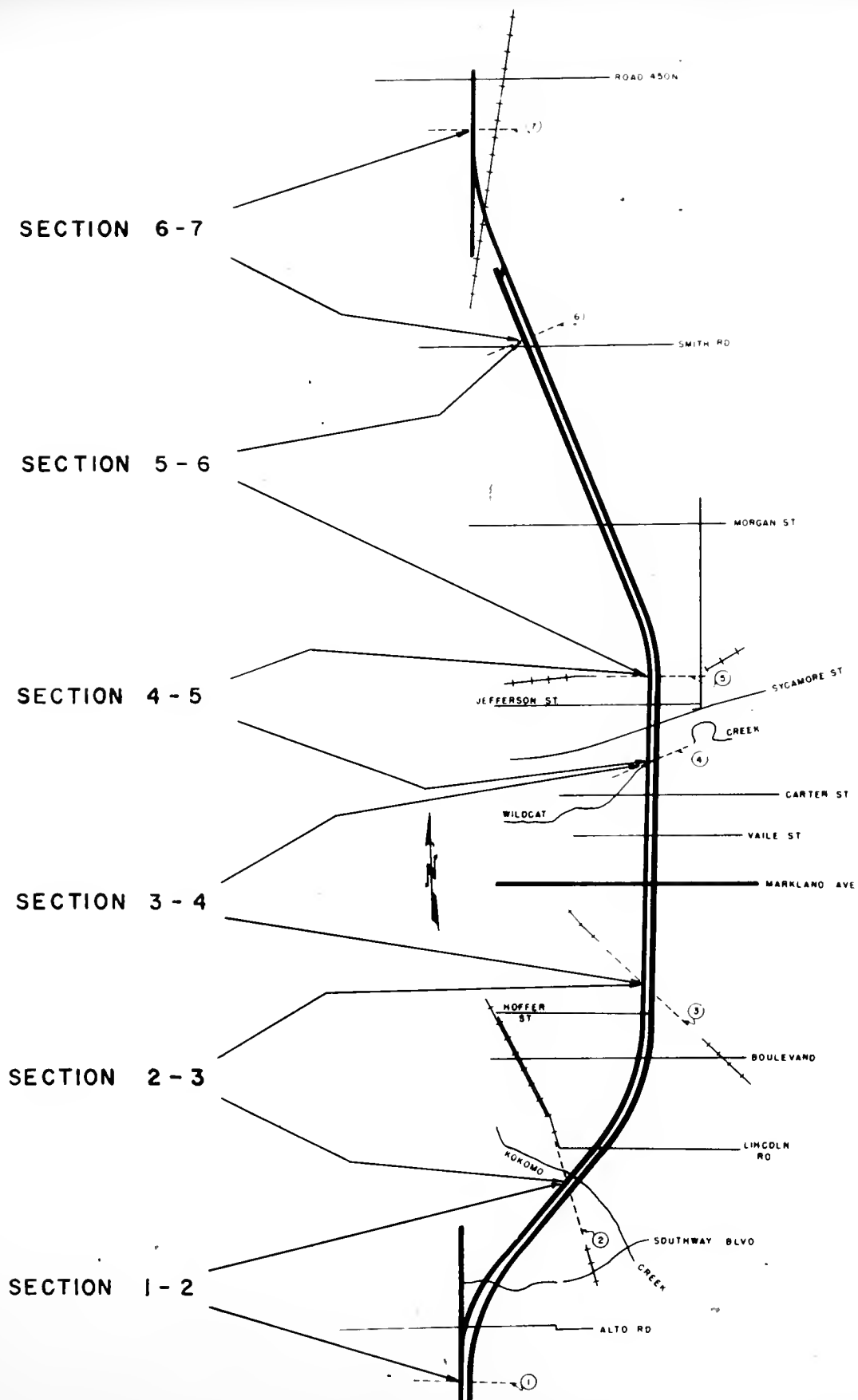


FIGURE 9 - SECTIONS OF THE KOKOMO BY-PASS FOR THE QUALITY CONTROL ANALYSIS

Section 4-5 for northbound traffic was found to be out of control. Several factors contributed to the high accident rate in this section. The most significant are sight distance, which is poor, and traffic speeds, which are high. Section 5-6 was also out of control but on the low side, a desirable finding. The major reason for the low accident rate in this section is the fact that little access is as yet necessary in this section to the by-pass.

Accidents would be reduced for southbound traffic on the by-pass by providing improved warning or a more gradual crossover at the north end of the facility in section 6-7. Accidents would also be reduced in section 1-2 by providing a left turning lane at Alto Road.

For the final phase of the accident analysis the accidents were classified by type as follows: (3)

- Type I - Intersection accidents which occur at the crossing of two traffic streams. These accidents are typically right-angle, turning, and rear-end collisions.
- Type II - Marginal accidents which occur along the moving edge of a traffic stream. These accidents result from vehicles attempting to enter or leave the traffic stream. Typical accidents are rear-end and access collisions.
- Type III - Medial accidents which occur between vehicles moving in opposite directions. Head-on collisions and side-swipes are typical accidents of this type.
- Type IV - Interstream accidents which occur among vehicles moving in the same direction. These include such miscellaneous accidents as running off the road, overturning, and some rear-end collisions. This type of accident will occur on any facility.

Figure 10 illustrates the accident trend by type from 1957 through 1964 for the Kokomo By-pass. The most pronounced increase is in the type I accident. Type III accidents have decreased since the facility was reconstructed into a four-lane divided facility.

Because types I and II accidents are virtually eliminated on a controlled access facility with grade separations, an economic analysis was conducted to determine the loss to the motorist because the facility was not of the controlled access type. Another way to visualize this approach is to ask: How much additional money could have been spent economically in 1950 for a controlled access facility which would have eliminated types I and II accidents? The assumptions and results are presented in Table 1. It is clear that at least an additional \$469,000 could have been spent in 1950 for the purchase and construction of full access control.

Land Use

With the variety of development that occurs along a new facility it is frequently difficult to determine which developments are a result of the new route and which would have been present had the facility not been constructed. Reasons for establishing along the Kokomo By-pass, however, seem to be more clearly defined. Most of the commercial and industrial developments in the vicinity of the by-pass either serve the motoring public or are dependent on the accessibility provided by the by-pass.

TABLE 1

PRESENT WORTH VALUE FOR 1950 OF TYPE I AND II ACCIDENTS

Assumptions:

1. Losses include property damage, personal injuries, and deaths attributed to vehicle accidents.
2. Yearly losses have been converted to 1950 present worth values.
3. Interest rate was assumed to be 4 percent.

<u>YEAR</u>	<u>1950 PRESENT WORTH VALUE</u>
1953 - June 1957*	\$ 192,796
1957 (1/2 year)	15,434
1958	17,407
1959	27,827
1960	32,548
1961	44,951
1962	48,436
1963	69,429
1964 (1/2 year)	<u>20,208</u>
Total	\$ 469,036

* From Reference 18 converted to 1950 present worth value.

Values for each year were not available.

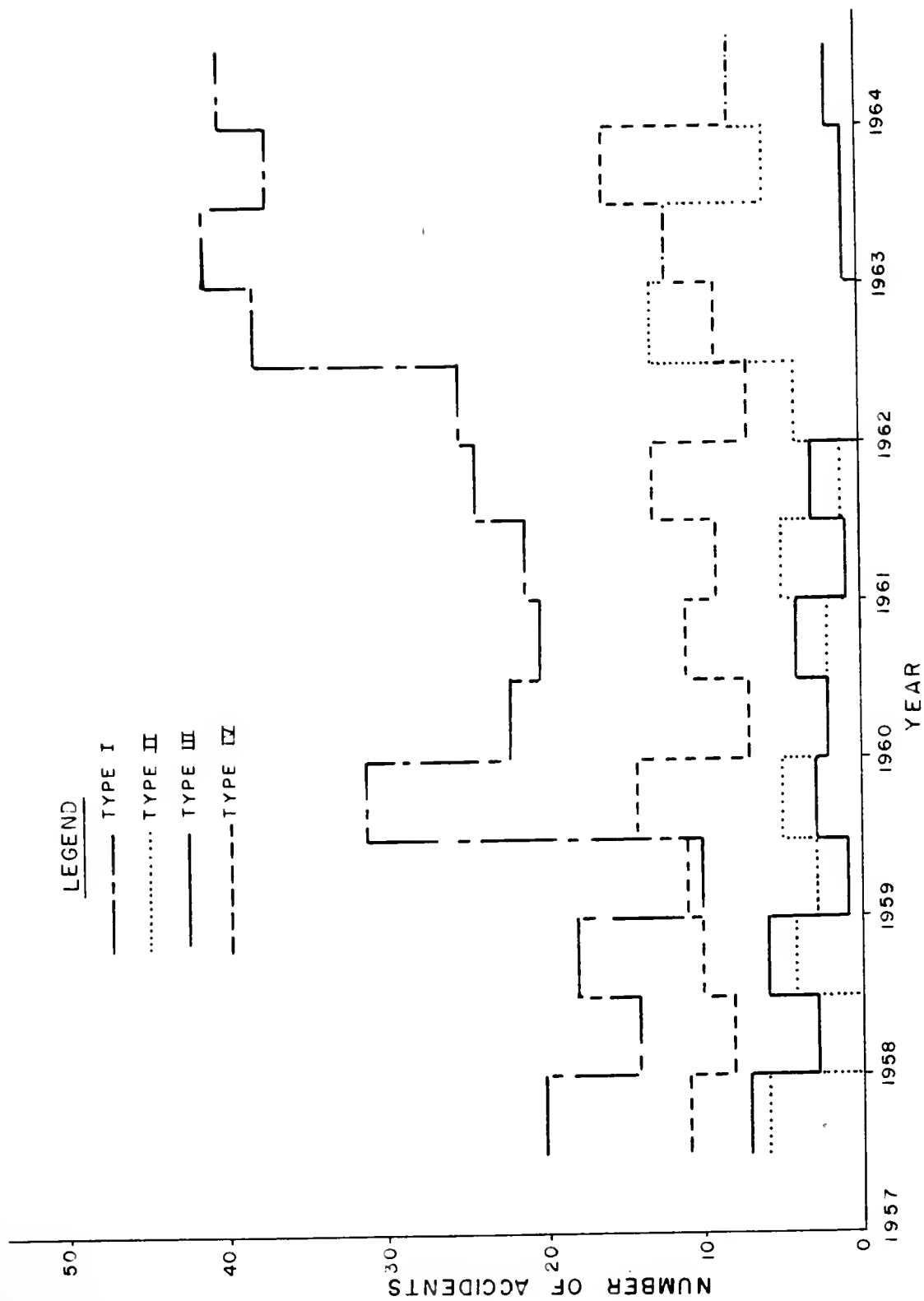


FIG. 10 - NUMBER OF ACCIDENTS BY TYPE AND YEAR

Land use patterns were compiled from 1938 to 1964 to more clearly portray the land use changes within one mile of the by-pass (see Figures 11 through 15). Prior to the construction of the by-pass the area was predominantly agricultural. During and after the construction of the Kokomo By-pass, businessmen began exploiting the economic possibilities which the by-pass was certain to provide.

The development adjacent to the by-pass includes industrial, commercial, and residential establishments. The growth of commercial establishments adjacent to the by-pass from 1951 to 1964 has been especially significant and is presented in Table 2. Much of Kokomo's new development is continuing to occur east of the city in the vicinity of the by-pass.

Land Value

After the location of a new highway has been determined, one of the first problems is that of purchasing right-of-way for the improvement. Many controversies naturally arise with respect to the degree of damage which a new highway will have on the surrounding area. Some have felt that the property owner often suffers a loss while others insist that the owner usually receives a substantial enhancement in property value.

In order to provide information for answers to the above question, land value data were collected from the Auditor and Recorder Offices in the Howard County Courthouse. After the land value data were collected, it was stratified into five bands by location of the land with respect to the by-pass. Each band was one mile in width (see Figure 16).

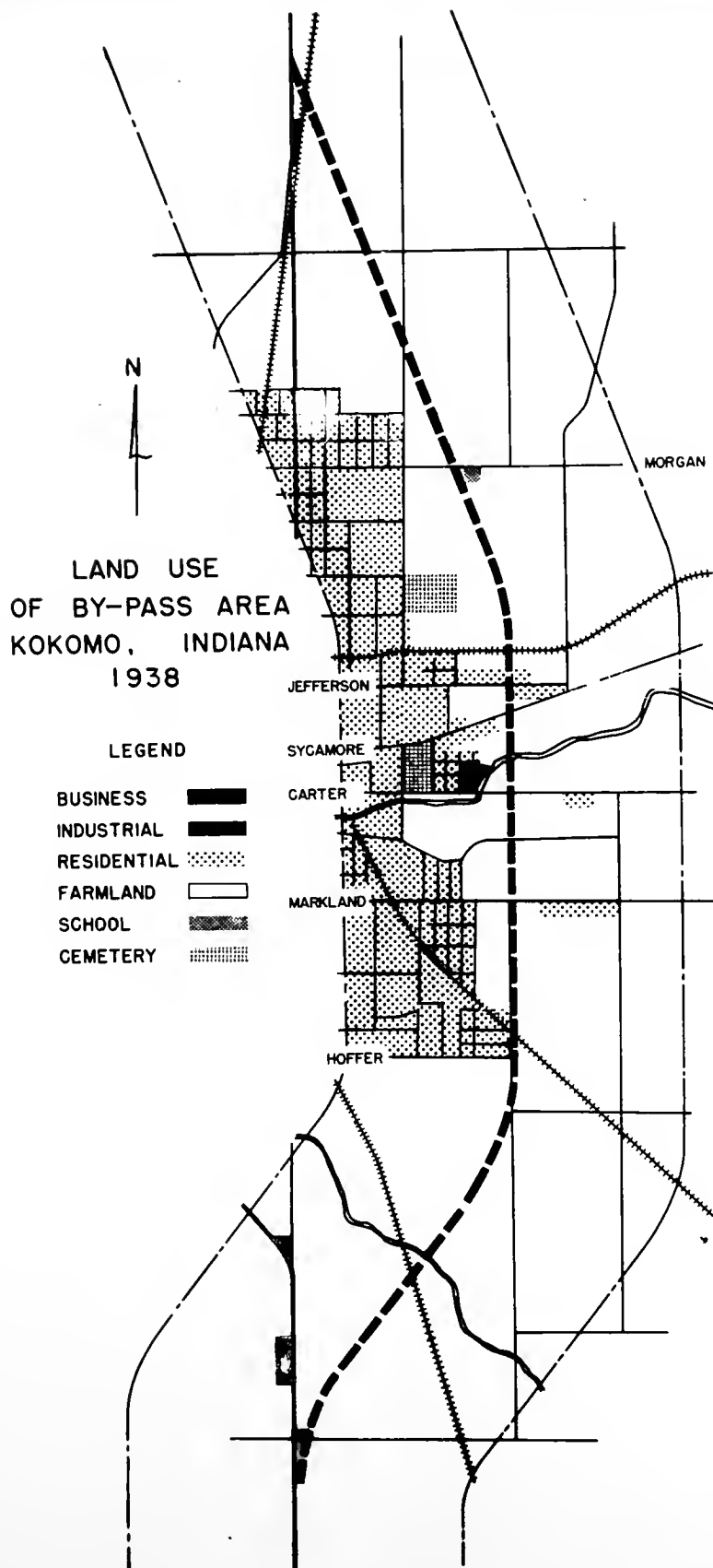


FIGURE II

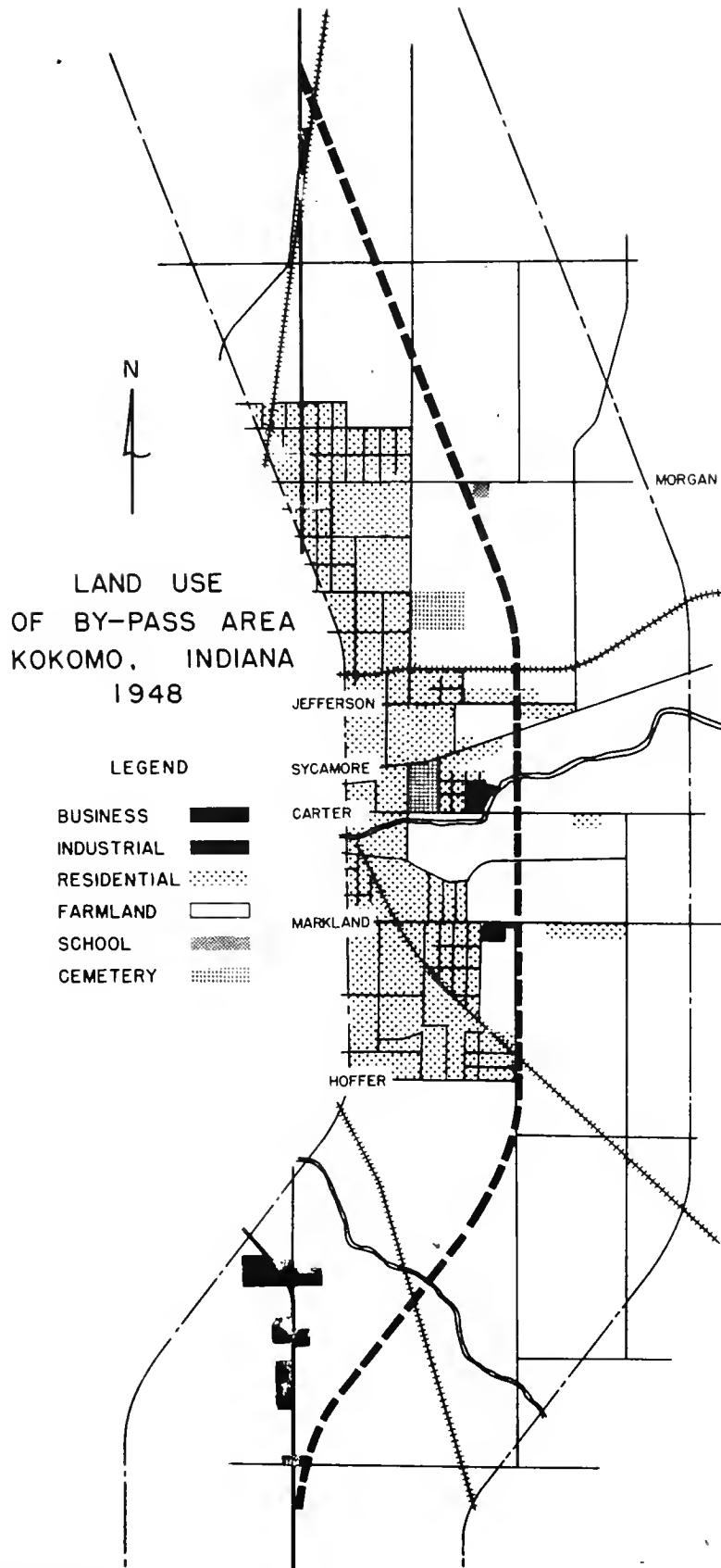


FIGURE 12

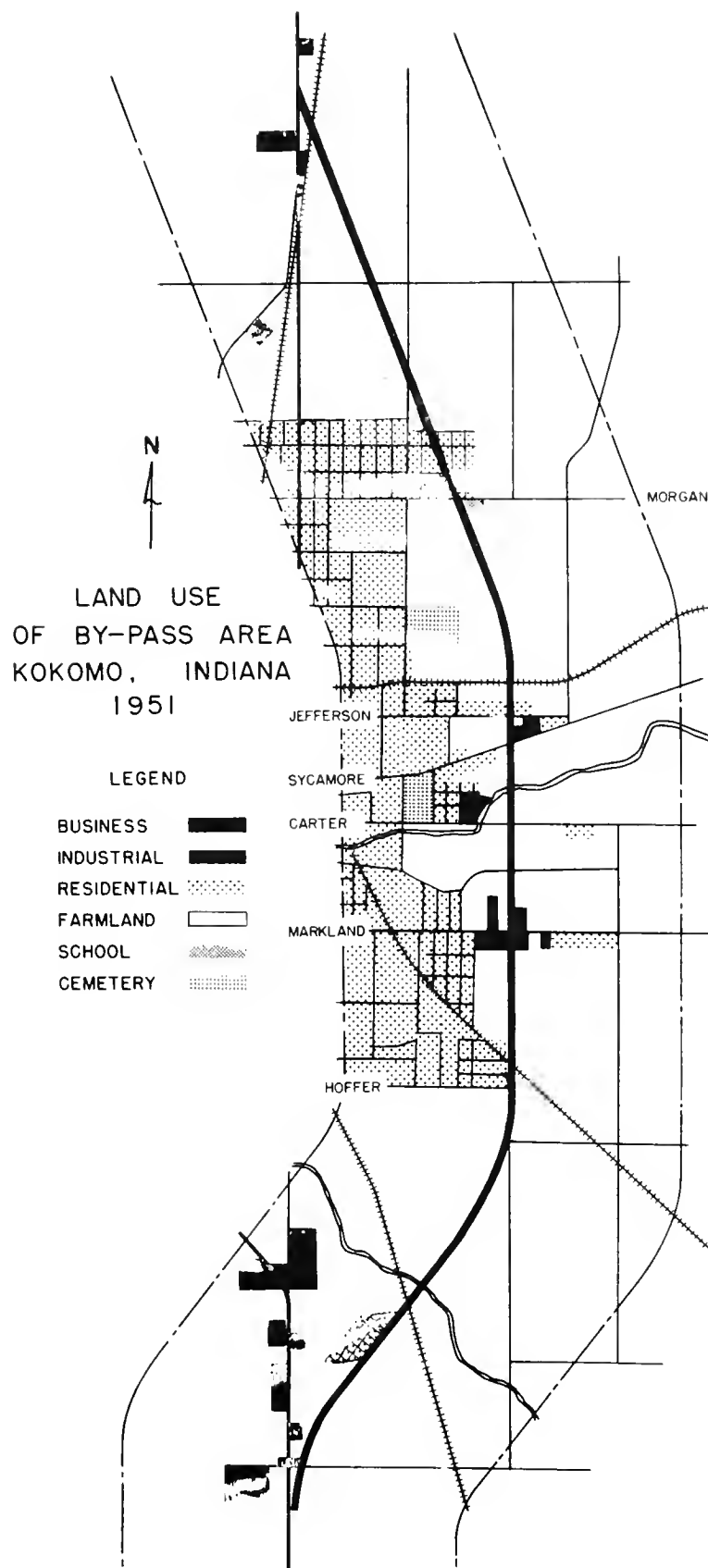


FIGURE 13

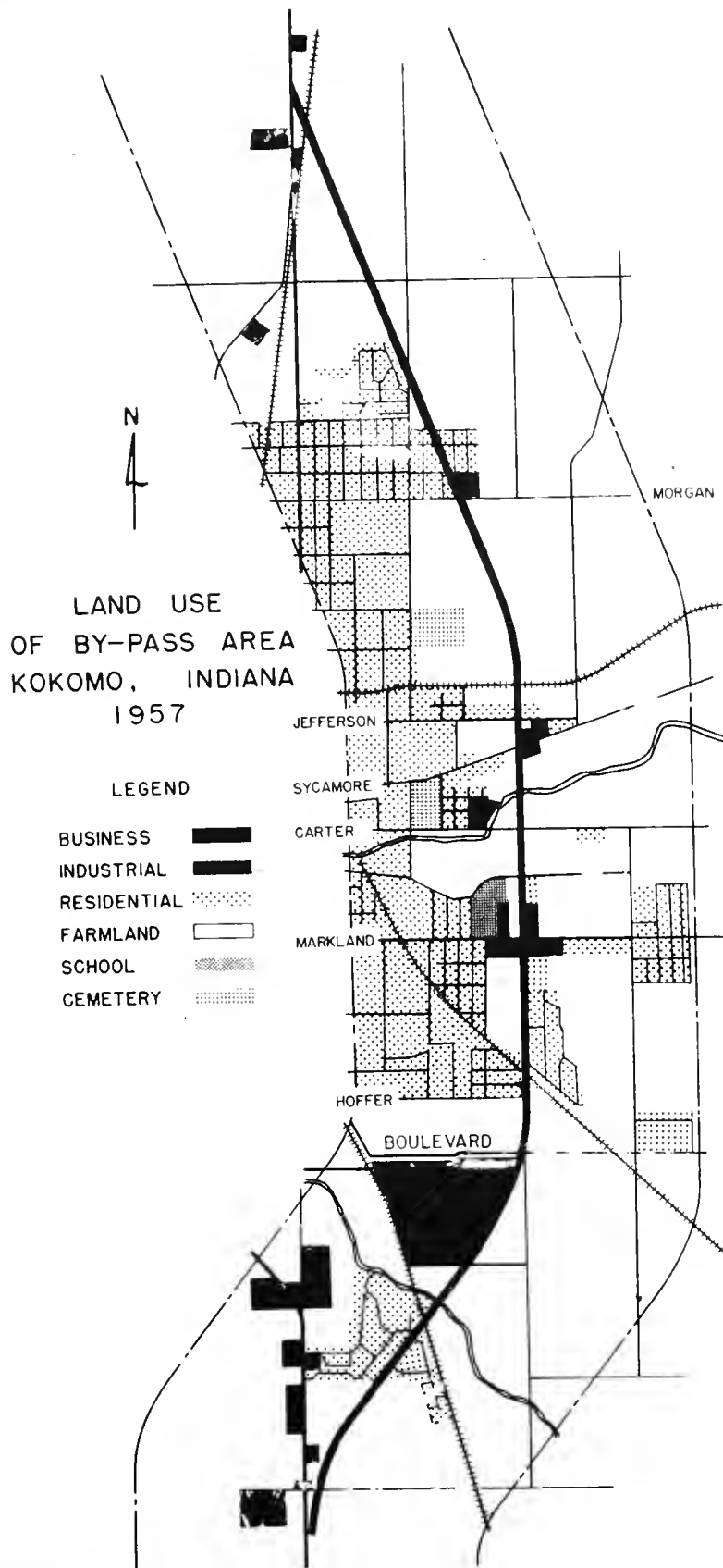








FIGURE 14

LAND USE
OF BY-PASS AREA
KOKOMO, INDIANA
1964

LEGEND

BUSINESS	
INDUSTRIAL	
RESIDENTIAL	
FARMLAND	
SCHOOL	
CEMETERY	

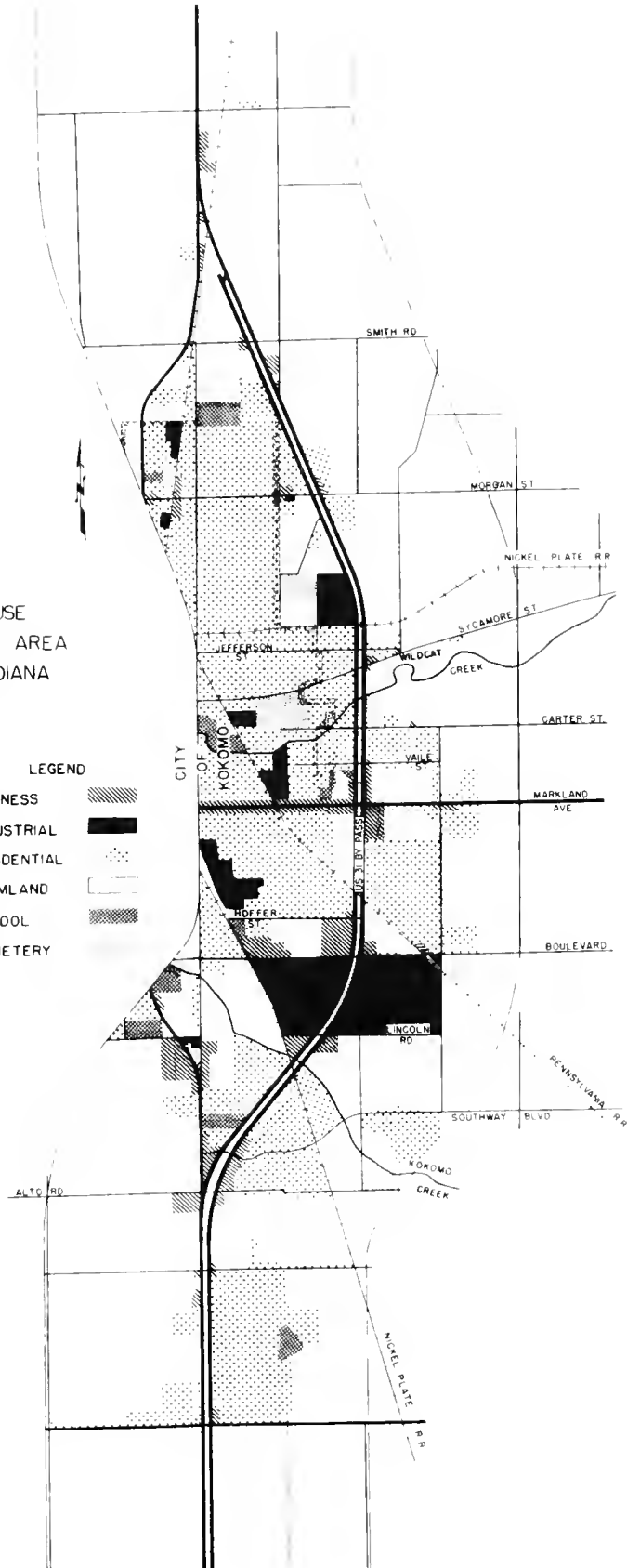


FIGURE 15

TABLE 2

ESTABLISHMENTS ADJACENT TO THE KOKOMO BY-PASS

	<u>1951</u>	<u>1957</u>	<u>1964</u>
Motels and Motor Lodges	--	3	5
Restaurants and Drive-ins	1	3	5
Service Stations	1	6	7
Used Car Lots	1	2	2
Retail Outlets	--	1	3
Grocery and Fruit Stands	--	1	1
Garages	--	2	3
Mobile Home Sales Lots	--	--	2
Repair Shops	1	1	6
Shopping Centers	--	--	1
Fire Stations	--	--	1
Office Buildings	--	--	3
Hospitals	--	--	1
Car-Washes	--	--	1
Laundries	--	--	1
Industries	--	--	2
Total	<u>4</u>	<u>19</u>	<u>44</u>

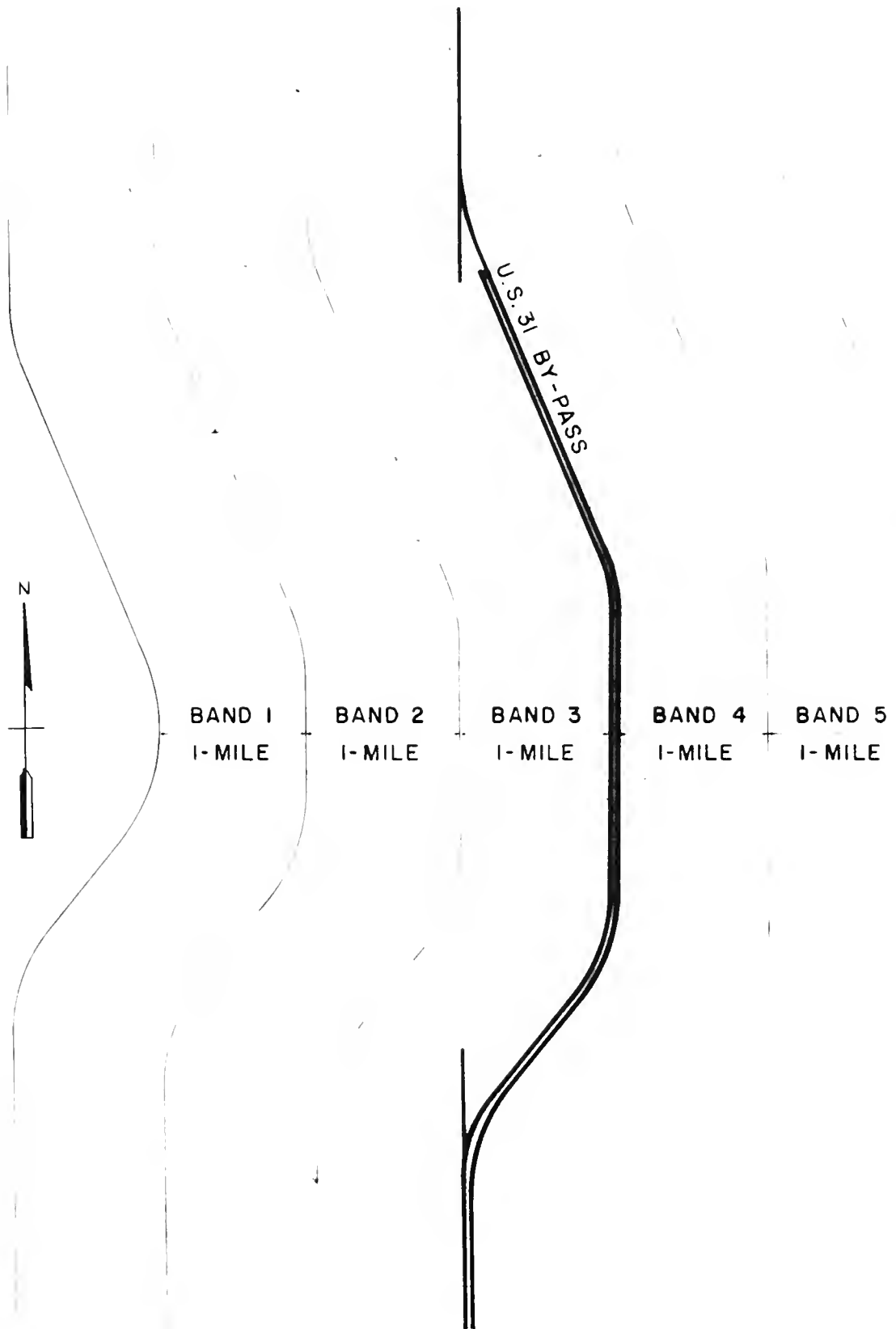


FIG. 16 - LAND VALUE BANDS PARALLEL TO THE BY-PASS

Figure 17 shows the results of the land value analysis. Band I includes the land on the west side of Kokomo and is in a comparable location as is the by-pass area on the east. It might reasonably be considered a control for suburban land values at Kokomo as it was not influenced by a highway improvement.

Land in band II, which includes the central portion of Kokomo, did not increase in value in the period from 1951 to 1956 as much as land in band I, the suburban area, but the increase in value from 1957 through 1963 was much greater. This increase in land value in the central portion of the city after 1956 may have been due to improved economic conditions in the city and to exploitation by businessmen of areas along old U.S. 31.

Land in band III has been in the highest demand. This illustrates the fact that in the period 1951-1963 much of Kokomo's new development has located between the by-pass and the city. The accessibility provided by the by-pass and availability of utilities were, with little doubt, primary reasons for these developments.

Band IV, the land east of and adjacent to the by-pass, shows a less pronounced increase in property value from 1951 to the present than that experienced by land in band III. This is probably due to the necessarily higher costs of providing utilities to this area, and also because this area is not as accessible to the developed area of Kokomo.

LEGEND

- BAND I
- BAND II
- BAND III
- BAND IV
- BAND V

4000

3000

2000

1000

0

DOLLARS PER ACRE

1945-50

1951-56

1957-63

YEAR

FIGURE 17 - MEAN VALUE PER ACRE OF LAND ALONG KOKOMO BY-PASS

Band V, the land more than one mile east of the by-pass shows the steady increase of rural land values in Howard County and possibly has not yet been affected by this highway improvement.

From Figure 17 it is concluded that the by-pass has had a positive economic effect on land values within one mile of the by-pass. This economic impact is affected by the distance from the by-pass and by the location of the already developed areas of the city.

A study of nine selected properties which were partially taken for the right-of-way for the Kokomo By-pass revealed that the remainder parcels were usually enhanced in value. This study showed that the greatest enhancement of land occurred when it changed from one use to another, as from agricultural to industrial. A further finding was that land value enhancement continued for many years following the completion of the highway improvement.

Summary of Findings

1. Travel volumes on the Kokomo By-pass increased three to five fold from 1951 to 1964.
2. In the years from 1951 to 1964 traffic volumes increased considerably on streets intersecting the Kokomo By-pass. This created considerable congestion and delay and increased the probability of accidents.
3. The number of accidents on the Kokomo By-pass has continually increased even after its reconstruction to a four-lane divided facility in 1960 for much of its length.

4. An accident spot map gives a poor measure of the degree of hazard at an intersection. The number of accidents at an intersection does not indicate hazard unless it is correlated with the traffic volume for that intersection.
5. Travel time required to traverse the city route (old U.S. 31) has increased only slightly from 1951 through 1964.
6. Travel time required to traverse the U.S. 31 By-pass has increased slightly from 1951 through 1964. This slight increase in travel time, however, was possible only because the route was reconstructed to a 4-lane divided facility from the initial 2-lane road.
7. Delays on the by-pass because of the four railroad crossings at grade were very minor.
8. Two incompatible motorist groups travel on the by-pass. These groups are local (Howard County) and non-local (non-Howard County) drivers. An analysis showed that there was a significant difference in speeds driven by the two groups of drivers with the local drivers traveling at a significantly lower rate of speed. It is probable that this variability in speed is a major contributor to vehicular accidents.
9. If the by-pass had been constructed as a controlled access facility with grade separations in 1950, an accident loss of \$469,000 (1950 present worth value of accidents 1953 - June 1964) probably would not have occurred.

10. The economic loss of travel time to motorists on the Kokomo By-pass was compared with a fictitious Kokomo By-pass of the freeway design. The value of the additional travel time required by motorists to traverse the by-pass in one year, 1964, was evaluated at \$270,000 because the by-pass facility was not of freeway design.
11. The Kokomo By-pass has had a pronounced effect on the location of new development at Kokomo. The major growth of Kokomo has been to the east in the vicinity of the by-pass.
12. Land values adjacent to the by-pass increased at a faster rate than land values in any other portion of the Kokomo area.
13. Land values along the city route (old U.S. 31) increased slowly following the construction of the Kokomo By-pass. After 1956, however, land values in the vicinity of the old city route increased substantially. It is therefore concluded that for the long term, the by-pass did not have a detrimental effect on property values along the old city route.
14. From a remainder parcel analysis it was concluded that many of the property owners who had land taken for the right-of-way of the highway improvement received sizeable enhancements before they sold the remainder parcels.
15. Land adjacent to the bypass which was converted from one use to another showed the largest increases in value.
16. From several case studies, the land value of property adjacent to the by-pass was found to have increased significantly with time.

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